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13. ABSTRACT (Maximum 200 words)

In 1995, TRADOC initiated the analytical process described in the March 1995 draft Joint Venture (JV) Campaign Plan. The resulting analyses provide the basis for redesigning today's Warfighting Army for the 21st century. The combat unit elements, combat service elements, and the combat service support elements needed to be analyzed individually to determine whether or not each of these sections would be able to effectively perform under the given scenario conditions. TRAC-Lee was tasked to analyze the CSS capabilities of the three (3) division designs (Conservative Heavy, Strike, Brigadist) for DDA Phase III. The three division designs were dynamically gamed using the Vector-in-Commander model in the LANTICA III, Northeast Asia 2.0, and Southwest Asia 4.2 scenarios. The CSS elements represented in VIC were analyzed by TRAC-Lee with the primary focus of the analysis was on the maintenance and supply operations and how the CSS units functioned for the given scenario.

This analysis concluded that the CSS structure in the Brigadist Division can support the division during a 24-hour battle such as the one portrayed in the Southeast Asia 4.2 scenario. There was one problem area in the CSS component that was focused on in this analysis. Some of the artillery units used all of their ammunition reserves and were not resupplied in a timely manner.

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STUDY TITLE: Combat Service Support (CSS) Vector-in-Commander (VIC) Analysis in Support of Force XXI Analyses Division Design Analysis – Phase III CSS Analysis of VIC Dynamic Gaming Brigadist Division Interim Design (South West Asia 4.2)

PURPOSE: The purpose of this analysis was to produce quantitative analysis of the Brigadist Division Interim Design's combat service support (CSS) structure which was dynamically gamed in the South West Asia 4.2 scenario with the VIC model. The focus of the analysis was on the maintenance and supply operations and how the CSS units functioned for the given scenario.

MAIN ASSUMPTIONS: The principal assumptions of this study include: (a) all repair parts were available upon request, (b) Echelons-Above-Division (EAD) were fully resourced, and (c) CSS enablers and other technological equipment are present.

PRINCIPAL FINDINGS: The CSS structure in the Brigadist Division could support the division during the 24-hour battle in the SWA 2.0 scenario with one exception. Several artillery units expended all of their ammunition resources at some time during the scenario and could not be resupplied in a timely manner.

IMPACT: This report suggests that the CSS structure in the Brigadist Division is sufficient to sustain the division in a scenario such as the one portrayed in SWA 4.2.

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Division Design Analysis -- Phase III CSS Analysis of VIC
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(South West Asia 4.2).
Technical Report



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Combat Service Support (CSS)
Vector-in-Commander (VIC) Analysis
in Support of Force XXI Analyses

Division Design Analysis -- Phase III
CSS Analysis of VIC Dynamic Gaming
BRIGADIST Interim Design (Southwest Asia 4.2)
16Aug97 VIC Analysis Data

1. General.

a. The Commanding General (CG) Training and Doctrine Command (TRADOC) tasked the TRADOC Analysis Center (TRAC) to conduct an analysis of the Combat Service Support (CSS) Division redesign concept. TRAC at Fort Lee, Virginia (TRAC-LEE) used Vector-in-Commander (VIC) analysis to provide quantitative analysis of that concept.

b. The dynamic gaming with the VIC model is based on the Southwest Asia 4.2 scenario with a total duration of 24 hours incremented in four hour time periods (TP) and four (4) hour reorder cycle time between CSS units. The modeled force consists of three brigades with a corps slice. Specific descriptions and details for both the scenario and modeled force are provided in the main report.

c. The analysis focuses first on those key maneuver unit resources necessary for a unit to perform its designated mission. The specific resources addressed are weapon system availability and the timely availability of supplies. Secondly, various aspects of the CSS system are examined to isolate bottlenecks or shortages which limit the provision of needed services. And conversely, excesses or under-utilized CSS resources are identified for this scenario.

d. The analysis entails two major areas: maintenance support and supply support. Since the medical support system for the treatment of personnel is very similar in function to that of the maintenance system, medical support is addressed along with maintenance.

e. VIC unit name designators are used in this report for brevity. Appendix A shows the cross reference between actual unit names and VIC unit names.

2. Model Description.

a. The Vector-in-Commander (VIC) model is a two-sided, deterministic simulation of integrated land and air combat. The level of resolution is the maneuver battalion. As a deterministic model, VIC relies upon expected values; weapon systems, transporters, inventories/stockage levels, and consumption can be fractional values. VIC is event stepped for maneuver elements and both time stepped and event stepped for calculation of combat service support (CSS) effects. The combat and combat support (CS) functions in VIC produce a workload for the CSS system. Two key modules within VIC are used to represent the CSS system: Return to Duty (RD - maintenance) and Logistics (LO - supply).

b. The return-to-duty (RD) module operates on equipment and noncrew personnel, both of which are referred to as systems, as well as crews for key combat vehicles.

(1) Workloads. The attrition modules generate combat casualty workload in the form of combat-damaged systems. These quantities are adjusted to factor out catastrophic damage/killed in action (KIA) and abandonments (equipment only) before becoming a workload on the RD system. Reliability failures to equipment and disease and nonbattle injury (DNBI) to personnel are also generated, resulting in their removal from units and their introduction as workload upon the RD system.

(2) Processes. The RD module contains representations of the recovery, evacuation, and repair functions.

(a) Recovery is constrained by the availability of operational recovery vehicles. Recovery operations are represented as a delay time of 57 to 96 minutes which includes round trip travel, hook-up, and drop-off. The recovery time varies from vehicle to vehicle and the primary location of that vehicle.

(b) Evacuation is constrained by the availability of operational evacuation vehicles and dynamic evacuation times that are a function of distance and time on the main supply route (MSR) network.

(c) Repair is constrained by the available strength and type of assigned mechanics or medical personnel. Of course repair throughput is impacted by the 'time to repair' but repair time is determined by design factors and not CSS. A maintenance unit's maintenance man-hours (MMH) is degraded by fifty percent when that unit has to relocate on the battlefield. This degradation is calculated to the nearest quarter of an hour; therefore, a maintenance unit's MMH during a portion of a TP could be degraded while the remaining MMH are unaffected. The degradation of MMH availability is based on the premise that a maintenance facility will have only 50 percent of its assets (to include personnel) fully functioning at any time during a battlefield relocation.

(3) Products. The final product of the RD module is the return of crewed systems to owning units. Intermediate products of the various RD processes include recovered systems, evacuated systems, and repaired systems.

(4) Combat impacts on RD processes. Impacts include attrition of RD assets, productivity degradation due to unit movement, changes in evacuation distances due to unit movements, and changes in evacuation speeds due to congestion of MSR links.

c. The logistics (LO) module provides the support structure to facilitate the resupply of ammunition, fuel, and other supplies to maneuver units and the restocking of these supplies at supply units.

(1) Workloads. The attrition modules dynamically generate the workload for ammunition as units engage in conflict. As units move and change posture they create a workload for fuel. A workload for other supplies is generated by a daily consumption rate, depending upon unit types. When maneuver units deplete their basic loads to specified reorder levels, a requirement for resupply is levied on the CSS system.

(2) Processes. The LO module contains representation of the resupply and move functions. Resupply to maneuver units is constrained by the availability of resupply vehicles, availability of supplies at supply units, load times, and travel time between the unit and its supplier. The availability of supplies at supply points is constrained by transportation, availability of load facilities, and load/unload times. The move function is constrained by the availability of CSS trucks, congestion of the MSRs, and travel times between supply units.

(3) Products. The final product for the resupply and distribution system is the replenishment of expended ammunition, fuel, and other supplies to maneuver units. Intermediate products include the restocking of resupply units and the movement of supplies along the MSRs from higher echelon supply units.

(4) Combat impacts on LO processes. Attrition and movement of supply units as a result of combat effects degrade the ability of these units to perform their resupply function. Resources which can be lost at the supply units include resupply vehicles, stocks, and materiel-handling equipment (MHE). The relocation of supply units results in degradation of their receipt/issue capability during the move. In addition, attrition of resupply vehicles, both at the maneuver unit and along the MSRs, degrades the ability of the CSS system to deliver supplies.

3. Assumptions.

a. Maintenance characteristics and parameters of all systems remain constant across the scenario.

b. When damaged weapon systems reach a maintenance facility, the correct tools, parts, and equipment are present at the facility. If the number of mechanics necessary to work on the damaged weapon system is available, they will begin working on the damaged weapon system immediately (i.e., prep time and time spent for damage assessment are not played in the model).

c. The DNBI rate remains constant across the scenario.

d. Resupply of all stockage items is available from echelons above corps (EAC).

4. Sufficiency Criteria.

a. Equipment. Maintain 80 percent availability of systems that have not been destroyed or abandoned. Rationale: Army Regulation (AR) 220-1, Unit Readiness Reporting, defines an equipment availability status of 80-90 percent as category C2 which is fully combat ready with minor risk.

b. Personnel.

(1) Have no weapon systems in awaiting-reissue queue due to nonavailability of crews. Rationale: The availability of weapon systems crews affects the availability criterion for combat systems.

(2) Maintain 80 percent personnel strength level for all modeled personnel. Rationale: AR 200-1 defines a personnel strength level of 80-90 percent as category C2 which is combat ready with minor risk.

c. Supply. Have no zero balance of any supply-class subitem (e.g., 155mm, 120mm, POL). Rationale: The lack of a specific type could adversely affect tactical options.

5. Maintenance Analysis.

a. The six weapon system categories covered in this analysis are shown in table M-1. The Fixed Wing category was not represented in the CSS system. In addition, medical treatment of personnel and weapon crews are presented as a separate category.

Category	Weapon System
TANK	M1A2
AFV	M2A3/TOW FSV/45MM BSFVE/STINGER M3A3/TOW
ADA	AVENGER
MLRS	MLRSD
CANNON	AFAS-D
HELICOPTERS	AH64D RAH66

Key Weapon Categories
Table M-1

b. The primary maintenance performance measure at the maneuver unit level is availability of unit weapon systems. Availability of unit weapon systems is determined by the current strength of weapon systems at a maneuver unit versus the initial strength less the number of catastrophically killed weapon systems at the same maneuver unit. The number of weapon systems available is a function of many dependent and interdependent factors. These factors can be partitioned into two groups: (1) those factors which render weapon systems inoperable: combat damage and reliability and (2) factors that contribute to the return of repaired systems to combat. When more weapon systems are returned to combat, a larger population is available for combat and reliability failure, which in turn workloads the Return-to-Combat (RTC) support system.

(1) Factors which cause weapon systems to become inoperable are combat damage and reliability failures. Combat damage is a function of the interaction of opposing forces resulting in catastrophic kills and repairable battle damage. The percentage of catastrophic kills versus the percentage of repairables varies by weapon system due to threat weapons and survivability characteristics. Table M-2 shows the percent repairable for each system once combat damaged. The percentages are not measures of overall survivability but are conditional results based on a weapon system first being combat damaged. Overall survivability also involves the likelihood of a weapon system being acquired and then being hit by the enemy. The percentages in table M-2 are, therefore, predicated on the occurrence of these two events.

Category	Weapon System
M1A2	93
M2A3/TOW	83
FSV/45MM	83
BSFVE/STINGER	83
M3A3/TOW	83
AVENGER	69
MLRSD	71
AFAS-D	49
AH64D	41
RAH66	41

Percent Repairable by Weapon
Table M-2

(2) Permanent losses of operational systems can occur in several ways. The most frequent is usually due to catastrophic combat damage. In addition, both types of candidate repairables (combat and reliability) are subject to weapon system abandonment at the maneuver unit or maintenance unit level. Maneuver and maintenance unit abandonment's of weapon systems occur due to immediate war-fight conditions, thus becoming permanent losses like catastrophic kills. Weapon systems can be traveling on an MSR when the scenario ends; thus these weapon systems are not considered part of a combat unit's arsenal. Another key factor which affects availability is the nonavailability of an owning unit. This occurs when a maintenance unit has repaired systems but does not have a maneuver unit in its area of influence with authorization to accept the system. In some cases, such weapons are never reissued during the scenario. Crewed weapon systems' RTC may be delayed because the appropriate number of crew members is not available to operate the weapon system. All five of these factors (catastrophic damage, abandonments, unit non-availability, weapons being reissued, and weapon systems waiting crews) are independent of the CSS system performance. Table M-3 shows the number of systems for each of these categories at the end of the scenario.

Weapon	# Weapons Waiting Units	# Weapons Waiting Crews	# Weapons Being Reissued	Maneuver Unit Abandonments	Catastrophic Kills	Total
M1A2	0.0	36.8	31.0	12.1	6.5	86.4
M2A3/TOW	0.0	2.9	17.6	1.3	10.3	32.1
FSV/45MM	0.0	16.1	1.3	0.0	5.1	22.5
BSFVE/STINGER	0.0	0.3	1.6	0.0	1.7	3.6
M3A3/TOW	0.0	0.0	0.0	0.2	0.5	0.7
AVENGER	0.0	Not crewed	1.2	0.0	1.1	2.3
MLRSD	0.0	0.0	0.0	0.0	1.9	1.9
AFAS-D	0.0	0.7	2.5	0.0	13.4	16.6
AH64D	0.0	0.0	0.0	0.0	7.7	7.7
RAH66	0.0	0.0	0.0	0.0	7.5	7.5
Total	0.0	56.8	55.2	13.6	55.7	

Weapon System Losses
Table M-3

(3) Reliability failures are based on mean hours between failures (MHBf) for the major subsystems of each weapon. The major subsystems for this study are Automotive, Armament, Helicopter, and Medical. Of course, the subsystems that fail or are damaged vary by weapon systems (e.g., the M1A2 is composed of both subsystems, automotive and armament, while only automotive is represented for the heavy equipment transporter (HET)). Each subsystem is serviced by a different mechanic type. In addition, the MHBf can vary by subsystem for each weapon. Helicopters, for this analysis, are serviced by a single type master mechanic although both automotive and armament failures occur for helicopters. In addition, all wounded/DNBI personnel are treated by a single medical type. The availability and performance of trucks used for resupply is addressed in the supply section of the report.

(4) Factors which influence the RTC of weapon systems are recovery, evacuation, and repair (to include medical treatment of personnel and crews) resources. Each of the CSS resources which performs these services is subject to both combat damage and reliability failure, which determine their availability for weapon system processing and treatment of personnel. Recovery and evacuation are performed on a designated priority basis, while repair and treatment are based on a more complex priority system. Further complicating the impact of repair on weapon system RTC are the repair characteristics of individual weapon systems. These characteristics vary by level of repair (i.e., unit, direct support (DS), general support (GS)), and mean time to repair for each type repair (combat, reliability). These characteristics represent a very complex interrelated system which determines the number of operational weapon systems.

c. Analysis. The maintenance analysis is divided into three sections (Support Services Sufficiency, Key Weapon Availability, and CSS Workload):

(1) Support Services Sufficiency.

(a) Recovery - Weapons.

1 With two exceptions, recovery operations serviced the recovery workload in a timely manner. "Timely manner" is defined as servicing the recovery workload within two TPs for a given maintenance unit. To meet this criterion the recovery workload at the end of one TP must be serviced in the next time period. The reason for this explanation of "timely manner" is to account for the maximum time of 96 minutes it takes for a recovery vehicle to assist in the recovery of a damaged weapon system or vehicle. If a vehicle requires an assisted recovery during the last half of the current TP, that vehicle would not reach the designated maintenance area until the next TP. The two recovery vehicles modeled are the improved recovery vehicle (M88) and a generic recovery vehicle (HMTWRECKER) which represent all other recovery vehicles which are not M88s. Table M-4 provides an overview of both recovery vehicle's status for the scenario where:

Initial Strength (stgn) is the assigned density at the start of the scenario.

End Strength (stgn) is the number operational at the end of the scenario.

End Availability is the percentage of initial strength available less the number destroyed or abandoned at the end of the scenario.

M88				HMTWRECKER			
Unit ID	Initial Stgn	End Stgn	End Availability	Unit ID	Initial Stgn	End Stgn	End Availability
DBSC	1	0.9	94	DBSC	4	3.9	98
B100002	1	0.9	94	B100002	3	3.0	98
B1100AR	2	1.7	85	B10000H	1	1.0	98
B1100EN	2	1.9	94	B1000DH	1	1.0	98
B1110AR	6	1.7	29	B1000LH	4	3.9	98
B1120AR	6	2.8	47	B1000UH	1	1.0	98
B1130MX	6	4.8	80	B1100AR	8	7.3	92
B1200EN	2	1.9	93	B1100EN	4	3.9	98
B1200MX	2	1.8	91	B1110AR	3	2.4	80
B1210AR	6	5.6	93	B1120AR	3	2.7	89
B1220MX	6	0.5	8	B1130MX	3	2.9	96
B1230MX	6	5.6	93	B1200EN	4	2.8	70
B1300EN	2	1.9	94	B1200MX	8	7.8	97
B1300MX	2	1.8	91	B1210AR	3	2.9	98
B1310MX	6	5.6	94	B1220MX	3	2.0	66
B1330MX	6	5.6	94	B1230MX	3	2.9	98
B1340AR	6	5.6	93	B1300EN	4	3.9	98
B3024AR	6	4.8	80	B1300MX	8	7.5	94
				B1310MX	3	3.0	98
				B1330MX	3	3.0	98
				B1340AR	3	2.9	98

M88 and HMTWRECKER Ending Availabilities
Table M-4

The "end availability" is a reliable indicator of availability and recovery support throughout the scenario. Table M-5 provides the combined recovery operations for all divisional maintenance units by TP.

TP	1.0	2.0	3.0	4.0	5.0	6.0
# RECOV.	73.0	41.9	23.3	28.1	29.6	21.6
WAITING RECOV.	14.6	6.0	4.6	13.2	12.7	11.0

Recovery Operations for All Divisional Maintenance Units
Table M-5

2 Recovery operations for the DBSC's single (1) M88 are listed in table M-6. As early as TP 1, the number of vehicles which needed to be recovered to the DBSC by a M88 was too large to be handled by the sole M88 at this unit. As many as 45 vehicles (TP 6) had to wait for the M88 to become available in order to be recovered. Among these vehicles were 13 IFV/TOWs, 12 PLS ammo trucks, 9 AFAS-Ds, 6 M88s, 2 BHETs, 2 FARVs, 2 M1A2s, and 1 MLRS.

TP	1	2	3	4	5	6
# RECOV.	2.9	2.9	2.9	2.9	2.9	2.9
WAITING RECOV.	15.4	24.3	26.1	37.5	43.6	45.2

M88 Recovery Operations for the Division Base Support Company
Table M-6

3 Recovery operations for the M88s located at the FSC that supports the 2nd brigade's 2nd mechanized infantry battalion are listed in table M-7. Approximately nine vehicles and weapon systems were waiting recovery at the end of TP 4 but only five were recovered in TP 5. One M1A2 and one M2A3/TOW were among the weapon systems not recovered during TP 5. In TP 6, two M1A2s, two M88s, two BCMDVEHs, and one M2A3/TOW were not recovered in a timely manner. During TPs 5 and 6, this FSC's M88 availability was around eight percent.

TP	1	2	3	4	5	6
# RECOV.	0.6	0.5	0.6	5.2	4.5	1.4
WAITING RECOV.	0.1	0.1	0.1	8.5	8.2	6.9

M88 Recovery Operations for the FSC supporting the 2nd
brigade's 2nd mechanized infantry battalion (Unit B1220MX)
Table M-7

4 Table M-8 lists the recovery workload for all maintenance units by recovery vehicle type.

Maintenance Unit	Recovered by		TOTAL	Maintenance Unit	Recovered by		TOTAL
	HMTWRECKER	M88			HMTWRECKER	M88	
B000000	71.7	17.2	88.8	B1130MX	2.3	11.3	13.6
B0MAINT	4.2	7.7	11.9	B1200EN	2.7	12.1	14.8
B100002	4.7	0.1	4.8	B1200MX	6.4	6.2	12.6
B10000H	2.4	0.0	2.4	B1210AR	2.6	3.1	5.7
B1000DH	2.5	0.0	2.5	B1220MX	3.3	12.7	16.1
B1000LH	2.6	0.0	2.6	B1230MX	2.5	3.7	6.2
B1000UH	2.6	0.0	2.6	B1300EN	0.3	8.1	8.4
B1100AR	7.1	8.0	15.1	B1300MX	10.5	10.9	21.4
B1100EN	0.1	9.3	9.4	B1310MX	2.5	3.1	5.6
B1110AR	2.8	16.4	19.2	B1330MX	2.5	3.3	5.8
B1120AR	2.8	15.6	18.4	B1340AR	0.0	18.6	18.6

Recovery Workload (by M88 and HMTWRECKER)
Table M-8

5 Conclusion:

M88 recovery shortfalls existed at the DBSC for the entire scenario because of the initial M88 strength. The FSC supporting 2nd brigade's 2nd mechanized infantry battalion had a M88 recovery shortfall during TPs 5 and 6 due to the low availability of M88s.

(b) Recovery - Personnel.

The recovery of injured personnel is implied; therefore, injured personnel do not require a recovery vehicle for transport from the battlefield to a medical facility. This phenomenon negates the possibility of a backlog of injured personnel needing recovery. Hence, personnel RTC will never be impeded by recovery assets.

(c) Evacuation - Weapons.

1 Evacuation support is performed in the scenario by HETs and a generic evacuation vehicle. The purpose of the generic evacuation vehicle is to represent the backhaul capability of other transporters. The analysis focuses on the HETs because they are considered potential constraints on evacuation. All but four of the key weapon systems utilize HETs for evacuation. The exceptions are AH64D, RAH66, AVENGER, and the PATRIOT. Only the performance of HETs is addressed. Weapon system evacuations are performed in a "timely manner" if damaged weapon systems are evacuated to the designated area (division only) within two TPs of the sustained damage.

2 Evacuation in this scenario is supported at the division area (unit B000000) with 24 HETs assigned. Evacuations occur for two reasons:

- designation of maintenance support at higher support levels.
- lengthy clockhour repair times (any vehicle or weapon system that requires more than seven clockhours to repair will be sent to the corps support area (CSB(DS)) so it will not 'tie up' mechanics at the ORG level with maintenance work that requires a considerable amount of time).
- maintenance overflow (maintenance overflow occurs when the number of hours needed to repair awaiting weapon systems exceeds a maintenance man hour threshold set for a maintenance unit).

3 Across the scenario, a maximum of nine percent of the corps forward area's HETs were not available at any given TP, all due to RAM damage.

4 There were twelve vehicle and weapon system evacuations to the corps forward area which required a HET (refer to table M-9). All twelve of these vehicles were AVLBs. All of these vehicles and weapon systems were evacuated to the corps forward area in a "timely manner."

TP	1	2	3	4	5	6
# EVACs.	1.2	2.4	2.2	2.1	1.8	1.8
WAITING EVAC.	0.6	0.7	0.7	0.7	0.7	0.7

Evacuation Workload - Division Area
Table M-9

5 Conclusion:

Evacuation is not a constraint on weapon system RTC.

(d) Evacuation - Personnel.

This function was not represented in the VIC model; therefore, no personnel evacuation output data was available for analysis.

(e) Repair - ground based weapons.

1 Sufficient repair support is determined by the availability of required mechanic types at the supporting maintenance facility for ORG/DS and GS levels. For the most part, FORCE XXI mechanics in the DISCOM are modular in that they can repair both ORG and DS level damaged vehicles. Table M-10 shows, for assigned ORG/DS level mechanics, the maximum MMH percentage utilized for each of the 21 maintenance facilities across the scenario. When this percentage is 100, sufficient mechanics were not available to service the workload (note shaded cells) at some point during the scenario.

2 There is one exception to the above described 100 percent indicator - maintenance backlog overflow. Resource status is reported only at the end of a TP thus making it possible that 100 percent utilization occurred within the TP but shows less at the end of the TP due to completion of repairs. So the condition can exist where the ending TP utilization is less than 100 percent but within a TP, conditions existed that caused maintenance backlog overflow.

3 In general, for those facilities with less than 100% utilization at the end of a TP, sufficient maintenance resources were always available. There were only minor exceptions when very small fractional workloads were evacuated due to backlog status and the MMH utilization was not 100%. Any under-utilized resources are not necessarily "excesses" but are indicators of the magnitude of the workload for this scenario. Force structure implications are not addressed in this report.

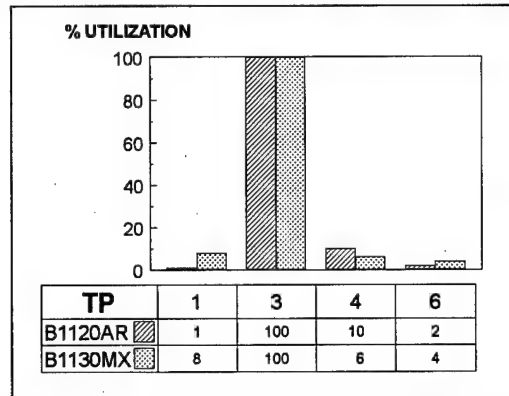
4 Figures M-1 through M-4 show the MMH utilization by mechanic type for those maintenance units with 100% utilization.

Unit Name	Armament		Automotive		Helicopter		Medical	
	Util. %	Str.	Util. %	Str.	Util. %	Str.	Util. %	Str.
B000000	1	19	100	36	0	10	87	12
B100002	27	11	8	21			20	12
B10000H	0	3	50	6	15	21	100	3
B1000DH	0	12	5	22	29	37	68	3
B1000LH	0	12	5	22	80	16	68	3
B1000UH	0	11	5	20	4	35	87	3
B1100AR	21	29	91	54			50	20
B1100EN	0	9	16	35			60	3
B1110AR	91	21	78	38			41	9
B1120AR	100	21	100	38			15	20
B1130MX	100	18	84	35			19	21
B1200EN	0	9	44	35			55	3
B1200MX	7	29	97	54			86	20
B1210AR	46	21	25	38			31	20
B1220MX	100	18	100	35			49	21
B1230MX	53	18	25	35			34	21
B1300EN	0	9	11	35			60	3
B1300MX	12	29	53	54			87	20
B1310MX	33	18	26	35			34	21
B1330MX	40	18	28	35			39	21
B1340AR	100	21	100	38			23	20

Utilization and Initial Strength by ORG/DS Level Mechanics
Table M-10

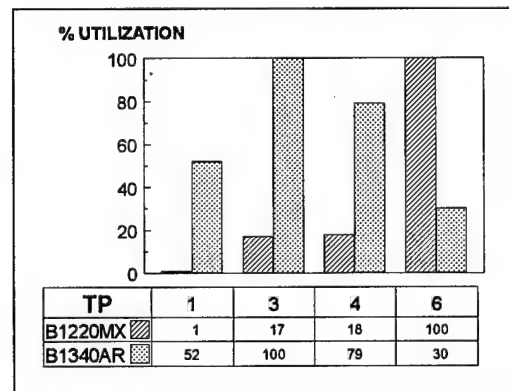
a Four maintenance facility's ORG level armament mechanics were 100 percent utilized: the 2nd and 3rd maneuver battalions' FSCs of the 1st brigade (units B1120AR and B1130MX), the FSC supporting the 2nd mechanized infantry battalion of the 2nd brigade (unit B1220MX), and the FSC supporting the 4th armor battalion of the 3rd brigade (unit B1340AR).

- The utilization of the 1st brigade's 2nd and 3rd battalion's FSCs (units B1120AR and B1130MX) can be found in Figure M-1. Both of these FSCs' armament mechanics reached 100 percent utilization during TP 3. No maintenance occurred at either of these facilities and only the 3rd battalion's FSC had any vehicles or weapon systems (one M2A3/TOW) waiting for repair at the end of the third TP. By the end of TP 4 the workload at these two FSCs was nearly non-existent.



ORG/DS Level Armament Mechanic Utilization for the
2nd and 3rd maneuver battalions' FSCs of the 1st brigade
Figure M-1

- The utilization of the armament mechanics supporting the 2nd mechanized infantry battalion in the 2nd brigade and the 4th armor battalion in the 3rd brigade is listed in Figure M-2.

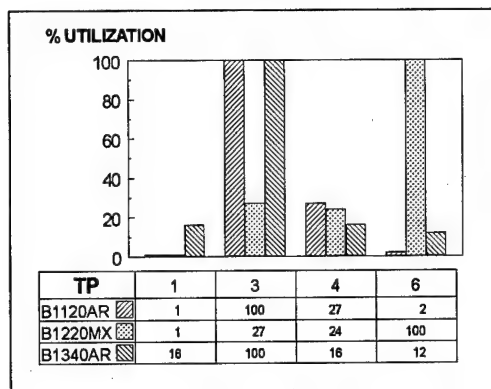


ORG/DS Level Armament Mechanic Utilization for the FSCs
supporting the 2nd battalion of the 2nd brigade (unit B1220MX)
and the 4th battalions of the 3rd brigade (unit B1340AR)
Figure M-2

- The armament mechanics in support of the 2nd brigade's 2nd mechanized infantry battalion (unit B1220MX) became fully utilized during TP 6. No vehicles or weapon systems had to be recovered to the 2nd brigade's BMC because of maintenance overflow, but there was a substantial number of key weapon systems waiting for armament mechanics to become available at the end of the scenario. These weapon systems are ten M2A3/TOWs, one M1A2, one BSFVE/STINGER, and one FSV/45MM. This was the same number and type of weapon systems that were waiting for repair at the end of TP 4. Thus combat damaged weapon systems in TP 4 were still waiting for armament repair at the end of the scenario.

- The armament mechanics in support of the 3rd brigade's 4th armor battalion (unit B1340AR) became fully utilized during TP 3. No vehicles or weapon systems had to be recovered to the 3rd brigade's BMC because of maintenance overflow, but there were a few key weapon systems waiting for armament mechanics to become available at the end of TP 3. These weapon systems were two M1A2s, one M2A3/TOW, and one BSFVE/STINGER. These weapon systems were repaired by the end of TP 4.

b Four maintenance facility's ORG level automotive mechanics were 100 percent utilized (see figure M-3): the division base support company (unit B000000), the FSC supporting the 1st brigade's 2nd battalion (unit B1120AR), the FSC supporting the 2nd brigade's 2nd battalion (unit B1220AR), and the FSC supporting the 3rd brigade's 4th battalion (unit B1340AR).



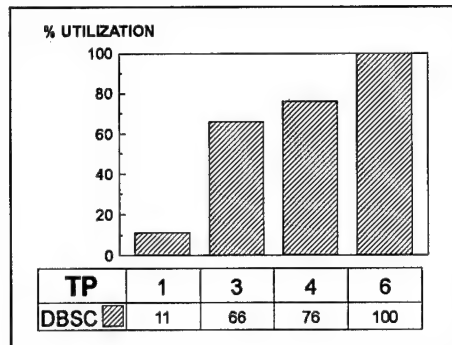
ORG/DS Level Automotive Mechanic Utilization for the
2nd Battalions of the 1st and 2nd Brigades and the
4th Battalion of the 3rd Brigade
Figure M-3

- The automotive mechanics in support of the 1st brigade's 2nd armor battalion (unit B1120AR) became fully utilized during TP 3. No vehicles or weapon systems had to be recovered to the 1st brigade's BMC because of maintenance overflow, but there were a few vehicles waiting for armament mechanics to become available at the end of TP 3. These vehicles were two HMMWVs, one medium truck, and one M88. These vehicles were repaired by the end of TP 4. These automotive mechanics were fully utilized because of the repair of twelve M1A2s during TP 3.

- The automotive mechanics in support of the 2nd brigade's 2nd mechanized infantry battalion (unit B1220MX) became fully utilized during TP 6 (the same TP when their armament mechanics reached full utilization). A number of vehicles or weapon systems had to be recovered to the 2nd brigade's BMC because of maintenance overflow. There were three M1A2s, two M2A3/TOWs, two medium trucks, one FSV/45MM, one 22 ton cargo truck, and one M88. There were also eight HMMWVs, three FSV/45MMs, and two medium trucks waiting for automotive repair at the end of the scenario.

- The automotive mechanics in support of the 3rd brigade's 4th armor battalion (unit B1340AR) became fully utilized during TP 3 (the same TP when their armament mechanics reached full utilization). Two M1A2s had to be recovered to the 3rd brigade's BMC because of maintenance overflow. There were also two HMMWVs waiting for automotive mechanics to become available at the end of TP 3. These two HMMWVs along with the other damaged vehicles and weapon systems were repaired in a timely manner from TP 4 on.

- Figure M-4 displays the ORG level automotive mechanic utilization for the located at the DBSC. Full utilization occurred during TP 6 for these mechanics. At the end of the scenario, there were eight AVLBs, five 22-ton cargo trucks, and three 5000 gallon fuel tankers waiting to be repaired. No vehicles or weapons systems had to be recovered to the CSB(DS) because of maintenance overflow.



ORG/DS Level Automotive Mechanic
Utilization for the DBSC
Figure M-4

c Table M-11 displays the CSB(DS)'s mechanic strengths and utilization. None of the mechanic types at the CSB(DS) became 100 percent utilized at any TP during the scenario.

Unit Name	Armament		Automotive		Helicopter		Medical	
	Util. %	Str.	Util. %	Str.	Util. %	Str.	Util. %	Str.
CSB(DS)	20	51	46	77	21	38	8	150

Utilization and Initial Strength of the CSB(DS) DS Level Mechanics
Table M-11

5 Conclusion:

No maintenance units within the DISCOM constrained key weapon system RTC with the exception of the FSC supporting the 2nd mechanized infantry of the 2nd brigade. This FSC could not handle the maintenance workload produced during the midpoint of this scenario. Two indicators of this would be (1) the number of weapon systems that were waiting for armament repair at the end of TP 4 and TP 6 was the same, and (2) the number of vehicles and weapon systems recovered to the BMC.

(f) Repair - helicopters.

Note: The AH64D (Apache) and the RAH66 (Comanche) are the systems represented by the helicopter weapon system category.

1 Sufficient helicopter repair support is determined by the availability of required helicopter mechanics at the supporting maintenance facility. The number of helicopter mechanics assigned to the helicopter battalions, the corps area, and division area can be found in tables M-10 through M-11. Note from these tables that none of the helicopter maintenance facilities had their mechanics 100% utilized during any TP of the scenario.

2 Recovery - The AH64D and the RAH66 do not require assisted recovery. If one of these helicopters receives non-catastrophic damage, that helicopter is assumed to self-recover. Helicopter RTC will never be impeded by recovery assets.

3 Evacuation - The AH64D and the RAH66 do not require a HET for evacuation. Instead, a generic evacuation vehicle is used to evacuate AH64Ds and RAH66s. The availability of HETs does not hamper the process of helicopter evacuation.

4 Conclusion:

None of the three CSS assets (recovery, evacuation, and repair) restricted helicopter RTC during the scenario.

(g) Medical treatment.

1 Personnel can be in one of the following three categories: combat ready, medical treatment process, or KIA. When injured personnel arrive at a medical facility, they receive treatment immediately, have to wait for the next available medic, or have to be evacuated to a higher echelon because of the severity of the wound. After treatment, injured personnel are returned to their respective unit. Refer to table M-12, at TP 5, the theater's Blue troop force was at 95%, its lowest availability during any TP of the scenario (the troop force availability at TP 5 was lower than the availability at TP 6 by .07 percentage points).

TP	Combat Ready	Being Treated	KIA	% AVAIL
0	16,028	0	0	100
1	15,493	502	33	97
2	15,412	582	34	96
3	15,417	572	39	96
4	15,305	637	86	96
5	15,102	800	126	95
6	15,123	778	126	95

Theater Personnel Profile
Table M-12

2 During the course of the scenario, the majority of personnel that are not combat ready are being treated or awaiting treatment at the corps area (e.g., at TP 5, 340 out of the 800 injured personnel are currently being treated or waiting for treatment at the corps area). When injured personnel have to be evacuated to corps, their severe injuries take approximately six days to treat; therefore, those persons will not return to duty for the remaining part of the scenario.

3 While the combined totals of the theater's Blue troop forces always remained above the 80% availability sufficiency criterion, one unit (unit B1220MX) fell below this criterion for two or more consecutive TPs. This unit is listed in table M-13 along with their troop combat availability percentage. The increase of combat intensity in the later part of the scenario and the treatment time of injured troops evacuated to the corps area are the two factors that contribute to the low troop availability at these units.

TP	1	2	3	4	5	6
B1220MX	96	95	94	77	75	74

Percentage of Personnel Available
Table M-13

4 Conclusion:

Medical repair teams organic to echelons lower than division did not constrain personnel RTC.

(2) Key Weapon Availability.

(a) Up to this point the analysis has addressed individual CSS support services (recovery, evacuation, repair, medical treatment) and their impact on RTC. With the exceptions noted, for the most part each of these support services was sufficient for the available workloads.

(b) The following section of the report, in effect, examines the cumulative effects of CSS services by looking at the availability of key weapons. Tables M-15 through M-24 provide unit level overviews for each key weapon system.

1 Each table (M-15 through M-24) contains the following information:

-Initial Strength (stgn) - weapon system density at the start of the scenario.

-End Strength (stgn) - weapon system density at the end of the scenario.

-Permanent Losses (K-kills) - catastrophic kills and abandonments.

-End % availability - weapon system availability at the end of the scenario.

This availability calculation excludes permanent losses in conformance with the earlier described sufficiency criteria. Permanent losses are excluded because their occurrence is independent of how well (or poorly) CSS performs.

2 Two phenomena appearing in the following tables warrant discussion:

a A "dead unit" is indicated when the "end strength" and "availability" are zero. A "dead unit" occurs when significant unit resources are decimated and that unit can no longer effectively function. Its surviving resources, damaged and undamaged, are distributed to repair or other units requiring weapons, respectively. The row in each table for dead units is shaded.

b One would expect the "end strength" to always be smaller than initial strength if there were permanent losses. This is not always the case because of the need based reissue of repaired (and crewed) weapons. Depending on the current available strength of a weapon, reissues are distributed proportionally higher to those units with the greatest need (lowest current strength) and not to the unit which originally "owned" the weapon.

(c) Results:

1 All weapon systems meet the availability sufficiency criteria (80%) except for the following case:

- The ending availability of the M1A2s at the following units was below the 80 percent mark: B1100CV (8%), B1110AR (23%), B1120AR (13%), B1130MX (3%), B1220MX (0%), and B1230MX (76%). The main reason for these units' M1A2s not maintaining a 80 percent availability strength was that 37 M1A2s were repaired and waiting to be reissued to their owning unit but were delayed because of insufficient crew members. Another 31 M1A2s were currently being reissued but had not reached their owning unit by the end of the scenario. The return of these 68 M1A2s would boost the above mentioned units weapon system availability. The number of M1A2s in the CSS queues (repair, recovery, and evacuation) was negligible at the end of the scenario; therefore, the CSS system did not constrain the M1A2's RTC.

- The ending availability of the M2A3/TOWs at the following units was below the 80 percent mark: B1110AR (58%), B1130MX (43%), and B1220MX (0%). The main reason for these units' M2A3/TOWs not maintaining a 80 percent availability strength was that 3 M1A2s were repaired and waiting to be reissued to their owning unit but were delayed because of insufficient crew members. Another 18 M2A3/TOWs were currently being reissued but had not reached their owning unit by the end of the scenario. The return of these 21 M1A2s would increase weapon system availability of units B1110AR and B1130MX

above the 80 percent mark, but unit B1220MX has an ending availability of zero percent and it would probably remain below the 80 percent availability mark for M2A3/TOWs. The armament and automotive mechanics at the FSC supporting unit B1220MX constrained the M2A3/TOW's RTC for this unit. Reference this unit in the "Repair - ground based weapons" section.

- The ending availability of the FSV/45MMs at the following units was below the 80 percent mark: B1100CV (21%), B1110AR (57%), B1120AR (44%), B1130MX (64%), and B1220MX (1%). The reason for the low ending availability of the FSV/45MMs in these units are the same as the M1A2s (18 currently being reissued).

2 The following table lists the only unit that was rendered combat ineffective ("dead") during the scenario, the time that the unit became ineffective, and the major weapon system(s) organic to that unit.

Ineffective "Dead" Unit	Time	Major Weapon Systems
B1201EN	0.6	GRIZZLY/AVLB

Units Rendered Combat Ineffective During the Scenario
Table M-14

3 Conclusion:

The mechanics at the 2nd battalion of the 2nd brigade constrained the return of M2A3/TOWs to combat. Otherwise, the CSS system did not constrain weapon system availability.

Reference (b).1. of Section (2), Key Weapon Availability -- end % availability is the weapon system availability at the end of the scenario. This availability calculation excludes permanent losses in conformance with the earlier described sufficiency criteria. Permanent losses are excluded because their occurrence is independent of how well (or poorly) CSS performs.

Unit ID	Initial Stgn	End Stgn	K-Kills	End % Avail
B1100CV	4	0.3	0.9	8
B1110AR	30	5.9	4.0	23
B1120AR	30	3.3	4.9	13
B1130MX	14	0.3	1.9	3
B1200CV	4	3.9	0.2	100
B1210AR	30	23.8	0.8	81
B1220MX	14	0.0	1.0	0
B1230MX	14	10.1	0.7	76
B1300CV	4	3.9	0.4	100
B1310MX	14	12.9	0.1	93
B1330MX	14	12.9	0.0	92
B1340AR	2	1.8	0.0	92
B1341AR	14	10.6	1.8	86
B1342AR	14	10.6	1.9	87
Total Permanent Losses			18.6	

M1A2 Status
Table M-15

Unit ID	Initial Stgn	End Stgn	K-Kills	End # Avail
B1100AR	3	2.4	0.2	84
B1110AR	14	7.3	1.5	58
B1130MX	30	11.0	4.7	43
B1200MX	3	2.6	0.0	87
B1210AR	14	11.0	0.7	83
B1220MX	30	0.0	4.9	0
B1230MX	30	23.2	1.6	82
B1300MX	3	2.8	0.0	96
B1310MX	30	28.5	0.3	96
B1330MX	30	28.2	0.3	95
B1343MX	14	12.8	0.2	92
B1344MX	14	11.8	1.3	93
Total Permanent Losses			15.7	

M2A3/TOW Status
Table M-16

Unit ID	Initial Stgn	End Stgn	K-Kills	End # Avail
B1110AR	1	0.6	0.1	64
B1120AR	1	0.6	0.1	60
B1220MX	1	0.0	0.2	0
B1230MX	1	0.8	0.1	87
B1341AR	1	0.8	0.1	90
B1342AR	1	0.8	0.2	91
Total Permanent Losses			0.8	

M3A3/TOW Status
Table M-17

Unit ID	Initial Stgn	End Stgn	K-Kills	End # Avail
B1110AR	4	2.7	0.2	70
B1120AR	4	3.0	0.1	76
B1220MX	4	0.0	0.7	0
B1230MX	4	3.7	0.0	93
B1341AR	4	3.8	0.4	100
B1342AR	4	3.8	0.4	100
Total Permanent Losses			1.8	

BSFVE/STINGER Status
Table M-18

Unit ID	Initial Stgn	End Stgn	K-Kills	End # Avail
B1100CV	13	2.5	1.1	21
B1110AR	6	3.3	0.3	57
B1120AR	6	2.5	0.4	44
B1130MX	6	3.7	0.2	64
B1200CV	13	11.4	1.1	96
B1210AR	6	5.6	0.0	94
B1220MX	6	0.1	0.7	1
B1230MX	6	5.8	0.0	97
B1300CV	13	12.1	1.3	100
B1310MX	6	5.7	0.0	95
B1330MX	6	5.7	0.0	95
B1340AR	6	5.9	0.0	98
Total Permanent Losses			5.1	

FSV/45MM Status
Table M-19

Unit ID	Initial Stgn	End Stgn	K-Kills	End # Avail
B000000	6	5.9	0.0	98
B1000DH	3	2.9	0.0	98
B1000LH	3	2.9	0.0	98
B1003M2	6	5.9	0.0	98
B1130MX	6	4.3	0.4	77
B1343MX	6	5.7	0.1	96
B1344MX	6	5.1	0.7	96
Total Permanent Losses			1.2	

AVENGER Status
Table M-20

Unit ID	Initial Stgn	End Stgn	K-Kills	End # Avail
B1001M2	3	1.7	0.6	72
B1002M2	3	2.0	0.4	79
B1003M2	3	1.3	0.8	60
Total Permanent Losses			1.8	

MLRSD Status
Table M-21

Unit ID	Initial Stgn	End Stgn	K-Kills	End # Avail
B1100H2	18	1.2	8.1	13
B1200H2	18	6.6	5.1	51
B1300H2	18	17.0	0.2	95
Total Permanent Losses			13.4	

AFAS-D Status
Table M-22

Unit ID	Initial Stgn	End Stgn	K-Kills	End # Avail
B1000DH	15	6.1	7.7	83
Total Permanent Losses			7.7	

AH64D Status
Table M-23

Unit ID	Initial Stgn	End Stgn	K-Kills	End # Avail
B1000DH	9	0.0	7.5	0
B1000LH	24	21.8	0.0	91
Total Permanent Losses			7.5	

RAH66 Status
Table M-24

(3) CSS Workloads. The following CSS workloads are provided to show the type and magnitude of workload serviced by each unit.

(a) Recovery and evacuation vehicle workload. The second column in table M-25 indicate the number of vehicles that required assisted recovery from their owning unit. The third through sixth columns show the number of vehicles that required evacuation 'in' and 'out' of a higher echelon maintenance unit.

Maint Unit	Total # of assisted recoveries		# EVAC'D IN		# EVAC'D OUT	
	HMTWRECKER	M88	TOTAL	w/ HET	TOTAL	w/ HET
CSB(DS)	71.7	17.2	11.5	11.5		
B100002	4.7	0.1				
B10000H	2.4					
B1000DH	2.5					
B1000LH	2.6					
B1000UH	2.6					
B1100AR	15.4	22.0			3.9	3.9
B1100EN	0.1	9.3			4.2	4.2
B1110AR	2.8	16.4			13.8	7.1
B1120AR	2.8	15.6				0.0
B1130MX	2.3	11.3			4.2	2.6
B1200EN	2.7	12.1			3.5	3.5
B1200MX	13.9	15.8			3.3	3.3
B1210AR	2.6	3.1				0.0
B1220MX	3.3	12.7			10.4	6.1
B1230MX	2.5	3.7				0.0
B1300EN	0.3	8.1			4.5	4.5
B1300MX	11.2	18.9			4.2	4.2
B1310MX	2.5	3.1				0.0
B1330MX	2.5	3.3				0.0
B1340AR	0.0	18.6			4.2	3.5

Recovery and Evacuation Workload
Table M-25

(b) Medical team workload. Table M-26 shows the number of personnel that arrived at a medical facility during the scenario due to combat and non-combat (DNBI)

actions. The last column displays the number of treatment man hours expended by all medical teams.

MEDICAL UNIT	CBT MEDICAL RECOVERED	DNBI MEDICAL RECOVERED	MMH EXPENDED	MEDICAL UNIT	CBT MEDICAL RECOVERED	DNBI MEDICAL RECOVERED	MMH EXPENDED
CORPS(R)	359.1	178.7	1,310.58	B1130MX	0.95	14.89	31.14
CSB(DS)	71.49	45.26	170.31	B1200EN	2.62	5.44	13.62
B100002	0.5	9.11	19.04	B1200MX	1.01	34.64	70.51
B10000H	0	23.17	26.74	B1210AR	0.06	13.54	26.69
B1000DH	0	8.29	16.27	B1220MX	5.48	13.71	34.87
B1000LH	0	8.24	16.15	B1230MX	0.1	15.24	30.16
B1000UH	0	9.37	19.73	B1300EN	0.17	7.15	14.36
B1100AR	1.98	34.46	72.24	B1300MX	0.79	37.84	75.46
B1100EN	0.01	7.15	14.18	B1310MX	0.52	15.17	30.42
B1110AR	1.01	12.85	27.14	B1330MX	1.75	14.92	31.65
B1120AR	0.54	10.6	22.09	B1340AR	1.06	12.55	26.52

Medical Unit Workload
Table M-26

(c) Maintenance team workload. Table M-27 shows the number of vehicles (both ground and air) that were recovered to a maintenance facility during the scenario. The last four columns display the number of maintenance man hours expended on ground and air vehicles and the estimated number of maintenance man hours required at TP 6 to repair all vehicles at the maintenance facilities.

MAINT UNIT	# VEHICLES RECOVERED		GROUND VEHICLES		HELICOPTERS	
	CBT DAMAGE	RAM DAMAGE	MMH EXPENDED	MMH NEEDED	MMH EXPENDED	MMH NEEDED
CSB(DS)	24.6	12.7	258.7	242.5	38.7	2.5
DBSC	0.0	83.8	195.4	204.7		
B100002	1.0	9.2	20.1	0.6		
B10000H	0.0	16.3	18.2	1.0	17.0	10.6
B1000DH	9.9	12.1	6.9	0.3	62.5	0.0
B1000LH	0.0	20.2	7.0	0.3	65.8	0.5
B1000UH	0.0	6.7	6.6	0.3	7.8	2.1
B1100AR	44.0	33.3	221.7	4.5		
B1100EN	3.2	8.6	30.5	22.3		
B1110AR	41.7	9.2	121.6	1.7		
B1120AR	38.6	7.6	158.3	1.9		
B1130MX	36.1	7.5	121.0	1.0		
B1200EN	15.0	6.9	48.6	25.4		
B1200MX	21.3	35.0	106.2	36.4		
B1210AR	3.0	14.1	50.9	6.7		
B1220MX	71.6	9.7	102.8	81.3		
B1230MX	3.8	12.1	44.0	8.0		
B1300EN	1.2	9.1	22.0	25.8		
B1300MX	32.8	40.6	139.6	5.6		
B1310MX	14.3	12.4	39.5	30.8		
B1330MX	15.7	12.5	41.5	33.1		
B1340AR	34.1	12.1	164.8	10.7		

Maintenance Unit Workload
Table M-27

(4) Observations.

1) M88 recovery shortfalls existed at the DBSC for the entire scenario because of the initial M88 strength. The FSC supporting 2nd brigade's 2nd mechanized infantry battalion had a M88 recovery shortfall during TPs 5 and 6 due to the low availability of M88s.

2) No maintenance units within the DISCOM constrained key weapon system RTC with the exception of the FSC supporting the 2nd mechanized infantry of the 2nd brigade. This FSC could not handle the maintenance workload produced during the midpoint of this scenario. Two indicators of this would be (1) the number of weapon systems that were waiting for armament repair at the end of TP 4 and TP 6 was the same, and (2) the number of vehicles and weapon systems recovered to the BMC.

3) The mechanics at the 2nd battalion of the 2nd brigade constrained the return of M2A3/TOWs to combat. Otherwise, the CSS system did not constrain weapon system availability.

6. Supply Analysis.

a. This analysis assesses the CSS system's capability to support combat and combat support units for the defined scenario. The CSS units must fill requests for replenishment stockages in a "timely fashion;" failure to do so can be attributed to lack of transporters, lack of stockages, long order-to-delivery times, or a combination of the three.

b. Analysis. This analysis is structured into two parts: supply class III and supply class V.

(1) Supply Class III.

(a) Requirement. For the scenario, the requirement for class III (petroleum) was found by summing the consumption (quantities "used" plus quantities "lost") of all maneuver units (CSS units were excluded from this computation) during each TP. Calculated in "gallons (gals)," the requirement for class III for the length of the scenario is presented in table L-1.

The consumption of supplies generates a requirement for stocks of supply types as well as transportation assets to deliver the replenishments to maneuver unit stockages. Consumption is translated into an order for materiel. Each order levies upon the CSS system a requirement for existing stocks and transportation assets. The authorized amount declines with time due to the attrition of weapon systems. Each weapon system has an authorized amount of specific supply types, and the authorized stockage is reduced as systems are killed. Table L-1 identifies the area of operation (AO) stockage levels and activities for class III: 1) amounts used; 2) amounts lost; and 3) amounts consumed (the requirement).

TP	USED GALS	LOST GALS	REQUIREMENT CONSUMED
0	0	0	0
1	17,002	4,485	21,487
2	10,602	2,598	13,200
3	12,096	310	12,406
4	25,080	1,608	26,688
5	11,472	1,410	12,881
6	11,517	324	11,842
TOTAL	87,768	10,735	98,503

Consumption of Class III, GALS
Table L-1

(b) Discussion. The resupply options for maneuver units are: 1) resupply is unnecessary (Balance on Hand $\geq 75\%$ of Authorized); 2) standard resupply (Balance on Hand $\geq 50\%$ & $< 75\%$ of Authorized); or 3) emergency resupply (Balance on Hand $< 50\%$ of Authorized); reference Appendix B for definitions of "standard" and "emergency" resupply. Table L-2 indicates that during three TPs only one maneuver unit had a BOH so low as to warrant the use of emergency resupply.

RESUPPLY	TP						
	0	1	2	3	4	5	6
RESUPPLY UNNEC	45	44	43	43	43	44	44
STANDARD RESUPPLY	0	0	0	0	0	0	0
EMERGENCY RESUPPLY	0	0	1	1	1	0	0
ALL UNITS ¹	45	44	44	44	44	44	44

¹ COMBAT INEFFECTIVE (DEAD) UNITS ARE NOT INCLUDED.

Number of Maneuver Units Needing Resupply, Class III
Table L-2

For more detail on individual units requiring resupply see table L-3 below. These units wait 1 TP before their BOH returns to a level no longer requiring resupply of class III.

Unit	TP							#TPs
	0	1	2	3	4	5	6	
B1000DH				50				1
B1000LH			29					1
B1000UH					47			1
#Units	0	0	1	1	1	0	0	3

Percentage of Balance On-Hand (%) for Maneuver Units
Requiring Resupply, Class III
Table L-3

For example, at the end of TP 4, B1000UH had a class III BOH of 47%. This was the only TP in which B1000UH could have asked for resupply. During TP 4, B1000UH was the only unit capable of requesting resupply.

(c) Problems. Table L-3 shows BOH percentage for individual maneuver units requiring resupply. A review of individual orders revealed no problems filling maneuver unit orders for CSS class III supply.

To quantify a measure of risk, the maximum consumption of class III by a unit for any TP is compared with the current BOH for each TP; if the value is less than one, the unit would exhaust its supplies prior to repeating the activities of this "maximum"

TP. Where "at risk" is less than one TP of supply, class III was generally provided to maneuver units without placing them "at risk". Only one maneuver unit was "at risk". See Table L-4.

			TP					
Unit	0	1	2	3	4	5	6	#TPs
B1000LH			1					1
#Units	0	0	1	0	0	0	0	1

"At Risk", Class III
Table L-4

(d) Observations.

- 1) Three maneuver units required emergency replenishment of class III.
- 2) There were no problems filling maneuver unit orders for Class III due to nonavailability of transporters or replenishment stockage.
- 3) In general, Class III CSS support was adequate and all maneuver units were supported in a "timely fashion".

(2) Supply Class V.

(a) Requirement. For the scenario, the requirement for class V (ammunition) was found by summing the consumption (quantities "used" plus quantities "lost") of all maneuver units (CSS units were excluded from this computation) during each of the 4-hour TPs. Calculated in "short tons (stons)," the requirement for class V for the length of the scenario is presented in table L-5.

TP	USED STONS	LOST STONS	REQUIREMENT CONSUMED
0	0	0	0
1	884	53	937
2	185	47	232
3	220	2	222
4	290	26	316
5	102	21	123
6	1	1	2
TOTAL	1,682	151	1,833

Consumption of Class V, STONS
Table L-5

(b) Discussion.

1) This analysis focuses on twelve munition types {155MM, ATACMS, MLRS, Hellfire, Longbow, Stinger, 120MM, 25MM, Javelin, TOWII, NATCMS, and Other Naval Systems} using five indices {Amount Authorized, Amount On-Hand, Amount Used, Amount Lost, and Ratio of Amount On-Hand to Amount Authorized}. A list of all corps and division assets listing VIC unit name designators and their actual unit names is contained in Appendix A. A list of all supply analysis definitions is contained in Appendix B.

a) The twelve aforementioned munition types were grouped into seven functional categories (Field Artillery, Aviation, Air Defense Artillery, Armor & Mechanized Infantry, Anti-Armor, Anti-Tank and Naval Systems). Each of the functional categories was divided into subcategories displayed in table L-6:

Category	Member Munition Type
Field Artillery	155MM - {M107 (CB), M116B1, M121A1, M449A1, M483A1, M549A1, M718+M741, M795, M825, M864, M864/AR, M864/GM, XM898, XM898/AR, XM898/GM, XM898_P3I, XM982, XM982/GM} ATACMS - {ATACMS I, ATACMS IA, ATACMS II, ATACMS IIA} MLRS - {M26, XM85, ER-MLRS/I, MSTAR/BAT_P3I, MSTAR/SADARM_PI}
Aviation	HELLFIRE, LONGBOW
Air Defense Artillery (ADA)	STINGER
Armor & Mechanized Infantry	120MM - {120MM, PGMM, M929, M933}
Anti-Armor	25MM - {25MM, 45MM}
Anti-Tank	JAVELIN, TOWII
Naval Systems	NATCMS - (NATACMS, NATACMS_I, NATCMS_IIA) Other Naval Systems - (ERGM/AA, EX171)

Key Functional Categories
Table L-6

b) Table L-7 displays the key munition types with the five aforementioned indices for each key munition at the end of the scenario. **The scenario end states shown are reliable indicators of individual unit supply status over the course of the scenario:**

c) Table L-7 represents an aggregation by munition type for all units in the modeled force. However, supply performance at some individual units for specific munitions varied significantly from these general indicators.

- The first column, key munition type, lists each of the munition types included for analysis in this report.

- The second column, amount authorized indicates quantities at initial state (TP 0) of the scenario.

- The total amount used of a key munition type (column three) can exceed the endstate BOH because during a particular TP a unit can receive a key munition type.

- Munitions lost due to combat activity (column four) did not cause any significant inventory imbalances resulting in availability shortfalls.

- The fifth and sixth columns, amount authorized and balance on hand (BOH) respectively, indicate quantities at endstate (TP 6) of the scenario.

- The seventh column, percentage of balance on hand of amount authorized, indicates that at endstate (TP 6) of the scenario, the quantity of munitions available for mission support was large and more than sufficient to meet requirements. **The Balance on Hand was at least one hundred percent of authorized for each munition type (except ATACMS, MLRS, and Other Naval Systems).**

Key Munition Type	Initial State	Consumption		Endstate		
	Amt Authorized {Rounds} @ TP0	Total Amount Used {Rounds}	Total Amount Lost {Rounds}	Amt Authorized {Rounds} @ TP6	BOH @ TP6 {Rounds}	Percentage BOH of Authorized
155MM	20,374	7,621	1,096	14,043	15,373	109%
ATACMS	188	93	2	110	100	91%
MLRS	1,835	1,137	37	1,037	733	71%
HELLFIRE	247	0	0	137	247	180%
Longbow	806	91	6	456	706	155%
STINGER	565	155	11	454	471	104%
120MM	17,973	675	412	9,815	16,885	172%
25MM	321,930	168	35,211	219,720	286,551	130%
JAVELIN	371	0	11	314	360	115%
TOWII	1,516	225	48	1,014	1,267	125%
NATACMS	600	156	0	600	600	100%
Other Naval Systems	12,000	1,186	0	12,000	11,830	99%

Key Munition Status
Table L-7

d) Table L-8 provides an overall summary of the additional supply indicators which helps assess the sufficiency of munition availability. Although the indicators are shown by munition type, the individual indicators represent the presence (Yes) or absence (No) of that indicator for some specific unit(s) in the force at the end of a specific TP. Tables L-9 thru L-20 provide more detailed analyses of the aforementioned munition availability criteria.

Key Munition Type	BOH (>=75%)	Standard Replenishment BOH (50%-74%)	Emergency Replenishment BOH (1%-49%)	BOH (=0)
155MM	Yes	Yes	Yes	Yes
ATACMS	Yes	Yes	Yes	No
MLRS	Yes	Yes	Yes	Yes
HELLFIRE	Yes	No	No	No
Longbow	Yes	No	Yes	No
STINGER	Yes	Yes	Yes	No
120MM	Yes	No	No	No
25MM	Yes	No	No	No
JAVELIN	Yes	No	No	No
TOWII	Yes	No	No	No
NATACMS	Yes	Yes	No	No
Other Naval Systems	Yes	No	No	No

Balance on Hand Status
Table L-8

- Balance on Hand (>=75%) of Authorized: Initially all units start in this range since the amount authorized is equal to the balance on hand. BOHs which remain in this range maintain a sufficient quantity of authorized munitions and at no time throughout the scenario require supply replenishment.

- Balance on Hand (50%-74%) of Authorized: This column indicates whether or not the BOH by munition type at any unit fell to the indicated percentage range of the authorized amount. BOH in this range triggers "standard supply replenishment" requests.

-- For seven of the munition types (HELLFIRE, LONGBOW, 120MM, 25MM, JAVELIN, TOWII, and Other Naval Systems) no standard supply replenishment was required at any time during the scenario. No HELLFIRE or JAVELIN munition type was expended during this scenario. Also, no HELLFIRE, NATACMS, or Other Naval Systems munition type was lost due to attrition of systems.

-- The other five munition types (155MM, ATACMS, MLRS, STINGER, and NATACMS) triggered standard resupply orders at some specific unit. Tables L-9 through L-13 identify the unit, the time period, and the sub-munition(s) which triggered a standard resupply order.

Unit Name	BOH(50%-74%)	Time Period(TP)	Sub-munition
1/1 Div Sup Arty Bn	72%	TP 2	M107/CB
1/2 Div Sup Arty Bn	61%	TP 1	M107/CB
	70%	TP 1	XM898 P3I
	51%	TP 1	XM982
	63%	TP 2	M107/CB
	58%	TP 2	XM898 P3I
	62%	TP 3	M107/CB
	58%	TP 3 & 4	M864
	53%	TP 3	XM898 P3I
	57%	TP 4	XM898 P3I
	71%	TP 5	M864

155MM Standard Replenishment
Table L-9

Unit Name	BOH(50%-74%)	Time Period(TP)	Sub-munition
A MLRS Plt (ATACMS)	70%	TP 4	ATACMS IIA
	71%	TP 5	ATACMS IIA
	67%	TP 6	ATACMS IIA

ATACMS Standard Replenishment
Table L-10

Unit Name	BOH(50%-74%)	Time Period(TP)	Sub-munition
B MLRS Plt	56%	TP 3	MSTAR/SADARM
	66%	TP 4	XM85

MLRS Standard Replenishment
Table L-11

Unit Name	BOH(50%-74%)	Time Period(TP)	Sub-munition
C MLRS Plt	53%	TP 2	STINGER
	73%	TP 4	STINGER
1/1 Armor Bn	61%	TP 1	STINGER
	67%	TP 2	STINGER
	68%	TP 3 & 4	STINGER
	65%	TP 5	STINGER
	66%	TP 6	STINGER
2/1 Armor Bn	74%	TP 2	STINGER
	70%	TP 4	STINGER
	66%	TP 5	STINGER
	67%	TP 6	STINGER
3/1 Mech Infantry Bn	71%	TP 4	STINGER

STINGER Standard Replenishment
Table L-12

Unit Name	BOH(50%-74%)	Time Period(TP)	Sub-munition
Ship 1	50%	TP 1	NATACMS_I
Ship 2	50%	TP 1	NATACMS_I

NATACMS Standard Replenishment
Table L-13

- Balance on Hand (1%-49%) of Authorized: This column indicates whether or not the BOH by munition type at any unit fell to the indicated percentage range of the authorized amount. BOH in this range triggers "emergency supply replenishment" requests. Five of the munition types (155MM, ATACMS, MLRS, LONGBOW, and STINGER) required emergency resupply. Tables L-14 through L-18 depict specific unit, time period, and sub-munition type which generate an emergency resupply request.

Unit Name	BOH(1%-49%)	Time Period(TP)	Sub-munition
1/1 Div Sup Arty Bn	14%	TP 1	M107/CB
	28%	TP 1	M864
	50%	TP 1	XM898_P3I
	49%	TP 1	XM982
	43%	TP 2	M864
1/2 Div Sup Arty Bn	32%	TP 1	M864
	30%	TP 2	M864
	9%	TP 3	M483A1

155MM Emergency Replenishment
Table L-14

Unit Name	BOH(1%-49%)	Time Period(TP)	Sub-munition
A MLRS Ply (ATACMS)	42%	TP 3	ATACMS_II
	12%	TP 4 & 6	ATACMS_II
	13%	TP 5	ATACMS_II

ATACMS Emergency Replenishment
Table L-15

Unit Name	BOH(1%-49%)	Time Period(TP)	Sub-munition
B MLRS Plt	27%	TP 1	MSTAR/BAT_P3I
	31%	TP 2	ER-MLRS/I
	29%	TP 4	MSTAR/SADARM
	17%	TP 5	XM85
	16%	TP 6	XM85
C MLRS Plt	1%	TP 4,5,6	MSTAR/BAT_P3I

MLRS Emergency Replenishment
Table L-16

Unit Name	BOH(1%-49%)	Time Period(TP)	Sub-munition
AH-64D/RAH-66 Attack Bn	13%	TP 5 & 6	LONGBOW
General Support Avn Bn	43%	TP 2	LONGBOW

LONGBOW Emergency Replenishment
Table L-17

Unit Name	BOH(1%-49%)	Time Period(TP)	Sub-munition
C MLRS Plt	43%	TP 1	STINGER

STINGER Emergency Replenishment
Table L-18

- Zero Balance on Hand: This column indicates whether or not the BOH by munition type at any unit fell to zero. Two of the munition types (155MM and MLRS) experience a zero balance on hand. Tables L-19 through L-20 depict specific unit, time period, and sub-munition type which experience a zero balance on hand.

Unit Name	BOH(=0)	Time Period(TP)	Sub-munition
1/1 Div Sup Arty Bn	0%	TP 4,5,6	M107/CB
1/2 Div Sup Arty Bn	0%	TP 4,5,6	M107/CB
	0%	TP 4	M449A1

155MM Zero Balance
Table L-19

Unit Name	BOH (=0)	Time Period (TP)	Sub-munition
B MLRS Plt	0%	TP 2 - 6	MSTAR/BAT P3I
	0%	TP 3 - 6	ER-MLRS/I
	0%	TP 5 & 6	MSTAR/SADARM PI
C MLRS Plt	0%	TP 3	ER-MLRS/I
	0%	TP 3	MSTAR/BAT P3I

MLRS Zero Balance
Table L-20

(c) Problems. Of the 388 stons ordered, via standard resupply, 177 stons were shipped (approximately 45.6 percent). Problems in unfilled orders are associated with unavailable transporters or replenishments (reference table L-21).

TP	REQUESTING UNIT	SUPPLY UNIT	SUPPLY TYPE	AMOUNT REQUESTED (Rounds)	AMOUNT SHIPPED (Rounds)	AMOUNT SHORTED (#)	TRUCKS AVAIL	AVAIL STOCKS (Rounds)
1	B1000DH	B1DAVSC	Longbow	244.0	72.0	70	0.0	285.5
1	B1000DH	B1DAVSC	B20MM	5,370.0	4,800.0	11	0.0	2,208.0
1	B1000LH	B1LAVSC	Longbow	224.0	36.0	84	3.9	0.0
1	B1000LH	B1LAVSC	B20MM	14,320.0	4,800.0	66	3.9	0.0
1	B1100H2	B001ASP	XM982	167.5	108.0	36	3.5	0.0
1	B1200H2	B002ASP	XM982	167.4	128.2	23	8.2	0.0
1	B1100H2	B001ASP	M549A1	101.3	50.2	50	3.5	0.0
1	B1200H2	B002ASP	M549A1	100.5	51.8	48	8.2	0.0
1	B1100H2	B001ASP	M864	140.7	2.5	98	3.5	0.0
1	B1100H2	B001ASP	XM898_P3I	624.5	80.0	87	3.5	0.0
1	B1200H2	B002ASP	M864	164.5	160.0	3	8.2	0.0
2	B1200H2	B002ASP	XM898_P3I	505.7	80.0	84	7.6	0.0
2	B1130MX	B113MSC	STINGER	10.4	8.6	18	0.0	8.5
2	B1200H2	B002ASP	XM982	312.8	290.7	7	7.6	0.0
2	B1000LH	B1LAVSC	Longbow	151.1	68.7	55	2.0	0.0
3	B1100H2	B001ASP	M864	71.3	64.1	10	7.6	0.0
3	B1000LH	B1LAVSC	STINGER	17.8	2.0	89	3.9	0.0
3	B1000DH	B1DAVSC	Longbow	121.1	68.7	43	0.0	38.4
4	B1200H2	B002ASP	XM898_P3I	780.3	77.4	90	7.6	0.0
4	B1300H2	B003ASP	M549A1	99.7	54.5	45	0.0	160.0
TOTAL				22,604.2	10,736.6	53		

Problems Filling Maneuver Unit Orders, Class V
Table L-21

- The problems of unfilled orders have rippled into maneuver units. In the table below, supply type-maneuver unit combinations that have a zero BOH are presented. The table has been coded: 0 - time and distance problems; 1 - unsupported materiel; 2 - insufficient replenishment stockages; and 3 - unavailable transporters. Generally, once a unit experienced a zero BOH, the zero BOH continued to the end of the scenario.

- From table L-22, zero BOH are attributed to shortages of transporters, shortages of replenishments, and large time-distances between maneuver units and their supporting CSS unit. The reader is cautioned regarding the "0"; some maneuver units consume everything on-hand, and cannot be provided a supply type fast enough regardless of the speed of the CSS system.

SUPPLY TYPE	MANEUVER UNIT	TP							
		0	1	2	3	4	5	6	# TPs
ER-MLRS/I	B1002M2				0	0	0	0	4
ER-MLRS/I	B1003M2				0				1
M107/CB	B1100H2					0	0	0	3
M107/CB	B1200H2					0	0	0	3
M449A1	B1200H2					0			1
MSTAR/BAT_P3I	B1002M2			0	0	0	0	0	5
MSTAR/BAT_P3I	B1003M2				0				1
MSTAR/SADARM_PI	B1002M2						0	0	2

Causes for Zero BOH
Table L-22

To quantify a measure of risk, the maximum consumption of class V by a unit for any TP is compared with the current BOH for each TP; if the value is less than one, the unit would exhaust its supplies prior to repeating the activities of this "maximum" TP. Where "at risk" is less than one TP of supply, class V was generally provided to maneuver units without placing them "at risk." Twenty-two maneuver units were "at risk." See Table L-23.

MANEUVER UNIT	TP							
	0	1	2	3	4	5	6	# of TPs
B1000DH				1				1
B1001DC		2	1	1				3
B1001M2		2	4	5	5	5	5	6
B1002M2		2	3	3	5	5	5	6
B1003M2		3	5	4	4	4	4	6
B1004M2		4	4	4	4	4	4	6
B1005M2		2	2	2	2	2	2	6
B1006M2		1	3	4	4	4	4	6
B1007M2					1	1	1	3
B1008M2		1	1	1	1	1	1	6
B1009M2		1	1	1	1	1	1	6
B1100H2	3	8	8	8	9	9	9	7
B1130MX					1			1
B1140RE		1	1	1	1	1	1	6
B1200H2	4	7	7	7	8	8	7	7
B1210RE				1	1	1	1	4
B1230RE				1	1	1	1	4
B1240RE					1	1	1	3
B1250AR	1	1	1	1				4
B1300H2	1	1	1	1	1	1	1	7
B1341AR		1	1	1	1	1	1	6
B5004SP		1	1	1	1	1	1	6

"At Risk" Units, Class V Risk
Table L-23

(d) Observations.

- 1) The primary causes for problems filling Class V CSS resupply requests were insufficient time, and length of travel distance.
- 2) The B MLRS Plt expended its supply of MLRS sub-munition type MSTAR/BAT P3I in TP 2 and ER-MLRS/I in TP 3 respectively.
- 3) Twenty-two maneuver units were "at risk".
- 4) Overall, the Class V CSS support was adequate and timely for all the maneuver units within the modeled force.

APPENDIX A

DDA VIC Name to Unit Name Cross Reference

VIC Name	Unit Name
BOMAIN	EAD maintenance
B000000	Div HQ
B001CSA	csb fwd/fuel
B001ASP	AMMO
B002ASP	AMMO
B003ASP	AMMO
B004ASP	AMMO
B001POL	FUEL
B001CSB	CSB FWD/FUEL
B001SUP	
B5001SP	Ship 1
B5002SP	Ship 2
B5003SP	Ship 3
B5004SP	Ship 4
B5005SP	Ship 5
B5006SP	Ship 6
B1100AR	1st Bde
B1110AR	1/1 Armor Bn
B111ASC	Armor Support Company
B1120AR	2/1 AR Bn
B112ASC	Armor Support Company
B1130MX	3/1 MX Bn
B113MSC	Mech Support Company
B1100H2	1/1 DS Arty BN
B11FASC	1/1 DS Arty support co
B1100FS	1/1 FSB
B1100CV	1/1 CAVALRY TROOP
B1100EN	1/1 Eng Bn
B1101EN	1/1/1 Engineer Co
B1102EN	2/1/1 Engineer Co
B1103EN	3/1/1 Engineer Co
B1200MX	2nd Bde
B1210AR	1/2 AR Bn(-)
B121ASC	Armor Support Company
B1220MX	2/2 MX Bn
B122MSC	Mech Support Company
B1230MX	3/2 MX Bn
B123MSC	Mech Support Company
B1200H2	1/2 DS Arty
B12FASC	1/2 DS Arty support co
B1200FS	1/2 FSB
B1200CV	1/2 CAVALRY TROOP
B1200EN	1/2 Eng Bn
B1201EN	1/1/2 Engineer Co
B1202EN	2/1/2 Engineer Co
B1203EN	3/1/2 Engineer Co
B1300MX	3rd Bde

VIC Name	Unit Name
B1310MX	1/3 MX Bn
B131MSC	Mech Support Company
B1330MX	3/3 MX Bn
B133MSC	Mech Support Company
B1340AR	TF SPARTANS
B1341AR	1st AR CO
B1342AR	2nd AR CO
B1343MX	1st MX CO
B1344MX	2nd MX CO from 2nd Bde
B134ASC	Armor Support Company
B1300H2	1/3 DS Arty
B13FASC	1/3 DS Arty support co
B1300FS	1/3 FSB
B1300CV	1/3 CAVALRY TROOP
B1300EN	1/3 Eng Bn
B1301EN	1/1/3 Engineer Co
B1302EN	2/1/3 Engineer Co
B1303EN	3/1/3 Engineer Co
B10000H	102 Avn Bde
B1000DH	AH-64D/RAH-66 Attack Bn
B1DAVSC	Attack Bn support Company (ft-lee 7-16-97)
B1000UH	GS Avn Bn
B1UAVSC	GS Avn Bn support Company (ft-lee 7-16-97)
B1000LH	Air Recon Sqdn FARP
B1LAVSC	Air Recon Sqdn support Company (ft-lee 7-16-97)
BNVYCH	Navy CH-53 Squadron
B10DASB	Div Avn Support Bn
B100002	DIVARTY HQ
B1001M2	MLRS plt (ATACMS)
B1002M2	MLRS plt
B1003M2	MLRS plt
B10FASB	Div FASB (-)
B1000DS	FWD SPT CO (less maint to B000000)

APPENDIX B

DEFINITIONS

Specific supply analysis definitions are listed below:

(1) Amount Authorized of this supply type: Amount of this supply type that this unit is authorized at the end of the TP, this number is calculated by multiplying the number of available systems that use this supply type by the amount authorized per system. This number can change from one TP to another due to weapon losses.

(2) Balance on-Hand of this supply type: Amount of this supply type that this unit has on hand at the end of the TP.

(3) Amount Used during this TP: Amount of this supply type that this unit used during this TP.

(4) Amount Lost during this TP: Amount of this supply type that this unit lost due to attrition of systems (when a system is damaged in combat a percentage (50%) of its on-board supplies are lost).

(5) Ratio of Balance on-Hand to Amount Authorized: A percent value used to indicate overall assessment of a munition; when this percent value is low, a greater risk is indicated as to possibility of exhausting all supplies.

(6) Total Amount Authorized during this TP: The sum of each amount authorized of each supply type at the end of the TP. The stockages are redistributed, consumed, or lost as the scenario proceeds. As units are engaged and attrited, the amount-authorized is reconciled with the number of surviving weapon systems.

(7) Total Amount on-Hand during this TP: The sum of the amount of each supply type that the units actually have in stock at the end of the TP. This amount is reduced by consumption, attrition, and other activities that may reduce the stockage of a supply type.

(8) Total Amount Used during this TP: The sum of the amount of each supply type consumed as a result of movement and combat at the of the TP.

(9) Total Amount Lost during this TP: The sum of the amount of each supply type lost due to attrition of systems at the end of the TP (when a system is damaged in combat, a percentage of its on-board supplies are lost).

(10) Total Amount on-Order during this TP: The sum of the amounts of each supply ordered by each unit during a period. As materiel is consumed, units initiate orders based on a re-order threshold to restock its supplies. If an order cannot be shipped for reasons of shortages of stocks or movers, a unit will re-order the replenishments during the next period.

(11) Timely fashion: The manner in which a unit is supported when a negative consequence did not result. When a maneuver unit calls for replenishment of supplies, the support of the maneuver unit shall be said to be in a "timely fashion," if the maneuver unit did not suffer for lack of supplies. For class III, a unit suffers when it is forced to stop for lack of class III. For class V, a unit suffers a negative consequence when it exhausts a class V supply type.

(12) Risk: The proportion of TPs that each supply type for each unit can be expected to last given the greatest consumption for the scenario. The higher the measure, the greater the quantity of stockage, hence the lower the likelihood of not being able to repeat the highest consumption of a TP.

(13) Standard Resupply: Maneuver units will generate an order for a supply type when, per the resupply schedule, the on-hand plus on-order quantity is less than 75 percent of the authorized quantity. The magnitude of the order is the amount of each supply type to bring the on-hand plus on-order quantity up to the authorized quantity. Routinely, the order is for 25% of authorized. When the shipment arrives, the on-hand balance will increase, and the maneuver unit will issue an order when the on-hand quantity again falls below the 75% authorized. Exceptions to this resupply process occur when, for lack of trucks or stocks, an order cannot be filled or shipped. When the order (or portion of same) cannot be shipped in the period it was requested, the unfilled portion is lost - there are no backorders or due-outs. The maneuver unit will reassess its needs during the next period. Standard resupply can be divided into two types: supply point distribution (SPD) and unit distribution (UD). A unit that uses SPD provides its own organic transporters to convey replenishments between the supply unit(s) and itself; a unit using UD requires the supply unit to provide both replenishments and transporters.

(14) Emergency Resupply: Maneuver units will generate an "emergency" order for a supply type when, per the resupply schedule, the on-hand plus on-order quantity is less than 50 percent of the authorized quantity. The magnitude of the order is the amount of each supply type to bring the on-hand quantity up to 50% of the authorized quantity. When the shipment arrives, the on-hand balance will increase. This is "emergency resupply." Emergency resupply is subject to a number of factors: (1) the availability of replenishment stockages; (2) the availability of helicopter support to provide airlift between the supporting CSS unit(s) and the requesting maneuver unit; and (3) the hostile environment surrounding the maneuver unit. If the scenario is short-lived or has intensive combat, the last factor can be the most limiting. Helicopters will not provide lift to maneuver units that are under assault. If any one of the factors prohibits emergency resupply, the "emergency" request for replenishments will be routed for "standard" resupply. When the order (or portion of same) cannot be shipped in the time period it was requested, the unfilled portion is lost - there are no backorders or due-outs - the unit must wait for the next period per the resupply schedule to assess its stockage position and re-order.

APPENDIX C

FIGURES AND TABLES

TP	USED GALS	LOST GALS	REQUIREMENT CONSUMED	AMOUNT RECEIVED BY AIR	AMOUNT RECEIVED BY TRUCK	AMOUNT REQUESTED	AMOUNT SHIPPED	% of ORDERED
0	0	0	0	0	0	0	0	---
1	17,002	4,485	21,487	0	0	19,349.31	19,349.31	100
2	10,602	2,598	13,200	0	5,687	3,816.23	3,816.23	100
3	12,096	310	12,406	0	4,621	4,323.34	4,323.34	100
4	25,080	1,608	26,688	0	5,375	5,791.68	5,791.68	100
5	11,472	1,410	12,881	0	4,950	5,547.87	5,547.87	100
6	11,517	324	11,842	0	5,986	2,406.06	2,406.06	100
TOTAL	87,768	10,735	98,503	0	5,350	41,234.49	41,234.49	100

Consumption of Class III, Gallons
Table C-1

TP	USED STONS	LOST STONS	REQUIREMENT CONSUMED	AMOUNT RECEIVED BY AIR	AMOUNT RECEIVED BY TRUCK	AMOUNT REQUESTED	AMOUNT SHIPPED	% of ORDERED
0	0	0	0	0	0	0	0	---
1	884	53	937	42	61	157	53	34
2	185	47	232	0	275	65	23	35
3	220	2	222	19	145	35	29	83
4	290	26	316	38	43	121	61	51
5	102	21	123	19	19	10	10	100
6	1	1	2	0	9	0	0	---
TOTAL	1,682	151	1,833	118	553	388	177	46

Consumption of Class V, STONS
Table C-2

CLASS III & V, TRUCKLOADS BY TP															
TP	7.62MM	B20MM	LONGBOX	M449A1	M483A1	M549A1	M795	M864	M929	POL-B	STINGER	TOWII	XM998_F3I	XM982	TOTAL
0															0
1	0.1	0.68	3			0.29		0.46		7.75	0.92	0.05	0.23	0.67	14.15
2			1.91					0.45		2.13	0.42		0.23	0.83	5.97
3			8.78					0.18		3.18	0.34	0.24			12.72
4			6.87	0.02	0.54	0.15	1		0.21	4.05	0.12		0.22	0.54	13.72
5				0.02	0.54			0.33	0.21	3.27	0.36				4.73
6								0.33		0.96	0.96				2.25

CLASS III & V, PERCENTAGE BY TP															
TP	7.62MM	B20MM	LONGBOX	M419A1	M483A1	M549A1	M795	M864	M929	POL-B	STINGER	TOWII	XM898_F3I	XM982	TOTAL
0															0
1	0.71	4.85	21.2			2.05		3.25		54.77	6.5	0.35	1.63	4.73	100
2			31.99					7.54		35.68	7.04		3.85	13.9	100
3			69.03					1.42		25	2.67	1.89			100
4			50.07	0.15	3.94	1.09	7.29		1.53	29.52	0.87		1.6	3.94	100
5				0.42	11.42			6.98	4.44	69.13	7.61				100
6								14.67		42.67	42.67				100

Truckloads On-Road, CSS-to-Maneuver Units
Table C-3

Unit Name	Amount Shipped	# of Deliveries	Minimum Time to Deliver	Avg Time to Deliver	Maximum Time to Deliver
B001POL	1,487.83	1	7.13	7.13	7.13
B1200FS	1,058.14	1	2.2	2.2	2.2
B1DAVSC	11,813.34	3	0.91	0.98	1.02
B1LAVSC	9,485.77	5	0.72	0.78	0.85
B1UAVSC	14,893.36	5	0.9	0.94	1.01

Order to Deliver, Class III
Table C-4

Unit Name	Amount Shipped	# of Deliveries	Minimum Time to Deliver	Avg Time to Deliver	Maximum Time to Deliver
B001ASP	304.74	5	0.49	0.5	0.5
B001CSA	41.09	3	5.7	5.7	5.7
B002ASP	290.71	10	1.22	1.42	2.24
B003ASP	433.26	3	0.89	0.98	1
B113MSC	40.08	3	0.74	0.84	0.93
B122MSC	8.78	1	0.59	0.59	0.59
B131MSC	70.43	1	2.22	2.22	2.22
B134ASC	23.85	3	0.74	1	1.43
B1DAVSC	5,119.14	4	1.19	1.4	2.02
B1LAVSC	7,337.75	6	0.45	0.89	1.03
B1UAVSC	17,866.89	2	0.53	0.53	0.53

Order to Deliver, Class V
Table C-5

CLASS III (BRIGADIST), AMOUNT ON-HAND BY UNIT BY TP							
	0	1	2	3	4	5	6
B000000	9,829.4	9,648.7	9,459.5	9,239.5	9,036.5	8,842.1	8,619.4
B0MAINT	10,972.1	10,703	10,421	10,090.7	9,784.7	9,488.4	9,146.8
B100002	1,605.2	1,581	1,555.5	1,525.5	1,497.7	1,470.9	1,440
B10000H	863.4	854	844	832.4	821.5	811	798.9
B1000DH	11,677.7	15,066.5	10,517.6	4,306.5	11,514.2	10,954.8	6,780.9
B1000LH	7,006	4,897.2	1,709.4	6,301.3	4,881.2	5,265.5	6,138.9
B1000UH	9,157.1	12,796.4	10,600.7	7,751.6	4,210.7	10,489.2	7,900.5
B1001M2	773.6	700.4	684.4	662.4	639.6	616.4	589.1
B1002M2	773.6	710.2	685.9	658.2	630.7	603.4	571.6
B1003M2	920.6	825	815.3	798.9	781.1	762.3	739.6
B1100AR	6,628.7	6,522.5	6,396.5	6,279.8	6,172.1	6,069.1	5,951.2
B1100CV	4,450.2	4,121.2	3,971.3	3,958.7	3,946.8	3,936.7	3,925.3
B1100EN	2,253	2,211.9	2,156.1	2,091.5	2,031.5	1,973.7	1,907.3
B1100H2	30,220.3	29,857.9	28,862.8	28,717.4	28,541.4	28,430.7	28,303.6
B1101EN	4,164	3,958.8	3,772.2	3,613	3,469.4	3,335.4	3,185.4
B1102EN	4,164	3,963	3,791.4	3,611	3,448.2	3,296.4	3,126.4
B1103EN	4,164	3,963	3,799.3	3,613.3	3,445.6	3,289.1	3,113.8
B1110AR	24,625.4	23,496.2	22,639.2	22,297.9	22,001	21,739.2	21,445.3
B1120AR	21,886.3	20,970	19,860.9	19,649.6	19,468.3	19,302.6	19,116.8
B1130MX	18,756.2	17,642.6	17,421	17,252.5	17,030.1	16,897.5	16,746.5
B1200CV	4,450.2	4,443.7	4,424.6	4,265.1	3,994.5	3,992.9	3,989.5
B1200EN	2,253	2,217.7	2,180.6	2,137	2,093.7	2,047	1,997.6
B1200H2	30,220.3	29,905.7	29,630	29,321.9	27,856.5	27,334.8	27,154.5
B1200MX	6,628.7	6,537.6	6,441.7	6,329.2	5,822.5	5,665.6	5,496.9
B1201EN	4,164						
B1202EN	4,164	3,941.7	3,710.4	3,438.7	3,193.6	3,024.7	2,835.7
B1203EN	4,164	3,941.7	3,710.4	3,438.7	3,186.7	4,009	3,744.4
B1210AR	23,767.9	23,674.5	23,577	23,462.9	20,250.6	20,142.5	20,142.5
B1220MX	19,466.7	19,336.6	19,233	19,023.7	16,208.2	15,652.8	15,652.8
B1230MX	19,466.7	19,365.8	19,260.2	19,136.8	16,364.7	16,111.3	16,111.3
B1300CV	4,450.2	4,197.8	4,086.2	3,837	3,831.3	3,824.2	3,816
B1300EN	2,253	2,217.7	2,180.6	2,137.1	2,096.7	2,057.8	2,002.2
B1300H2	30,220.3	27,572.3	27,301	26,982.9	25,222.1	24,017.9	23,746.7
B1300MX	6,628.7	6,537.6	6,441.7	6,329.1	5,797.8	5,645.6	5,475.8
B1301EN	4,164	3,941.8	3,713.1	3,448.2	3,205.4	2,970	2,700.3
B1302EN	4,164	3,941.8	3,713.1	3,448.2	3,209.7	2,968.8	2,701.7
B1303EN	4,164	3,941.8	3,713.1	3,448.2	3,205.4	2,984.6	2,729.5
B1310MX	18,609.2	18,509.7	18,405.8	18,284.1	16,439.5	15,673.7	15,673.7
B1330MX	18,609.2	18,509.7	18,405.8	18,284.1	16,535.6	15,491.9	15,491.9
B1340AR	5,964.3	5,063.9	4,997.8	4,920.6	4,616.7	4,548.1	4,469.2
B1341AR	8,061.5	7,073.9	7,070.5	7,064	7,056.2	7,048.1	7,038.7
B1342AR	8,061.5	7,082.1	7,078.7	7,072.3	7,037.2	7,029.1	7,019.7
B1343MX	3,444.7	2,956.2	2,941.5	2,924.1	2,908	2,892	2,873.5
B1344MX	2,886.1	2,454.2	2,443.6	2,430.5	2,417.8	2,404.2	2,388.1
BNAVYCH	18,169.2	18,169.2	18,169.2	18,169.2	18,169.2	18,169.2	18,169.2

Amount-on-Hand by TP, Class III
Table C-6